H. GROB.

ELECTRICAL SYSTEM.

APPLICATION FILED JAN. 30, 1911.

1,256,223.

Patented Feb. 12, 1918.

2 SHEETS—SHEET 1.

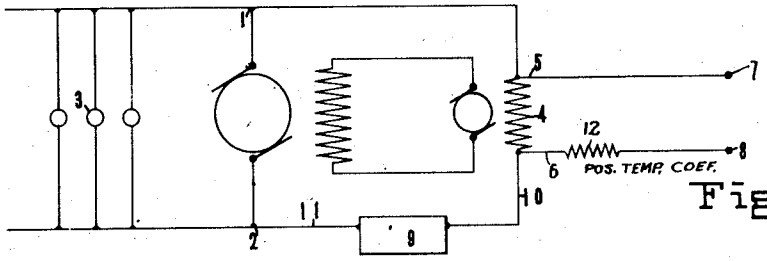


Fig. 1.

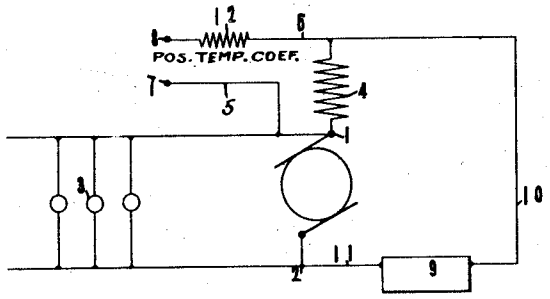


Fig. 2.

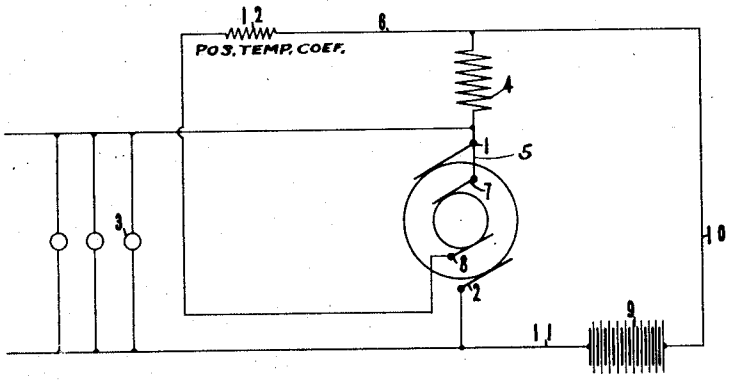


Fig. 3.

WITNESSES

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2 SHEETS—SHEET 2.

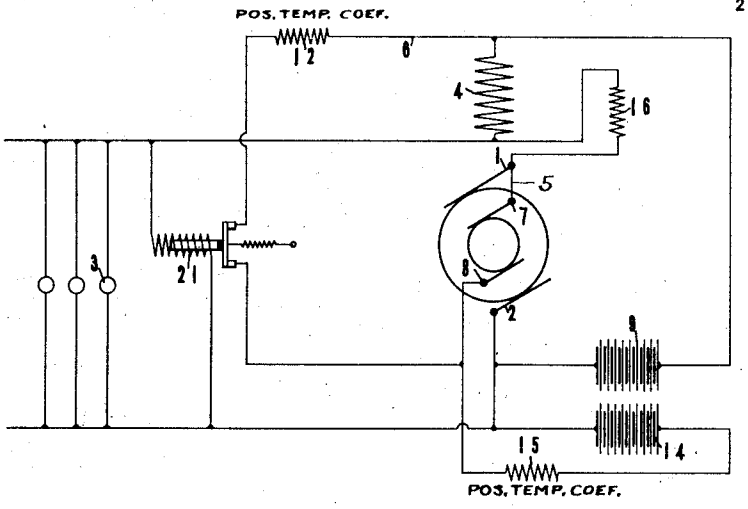
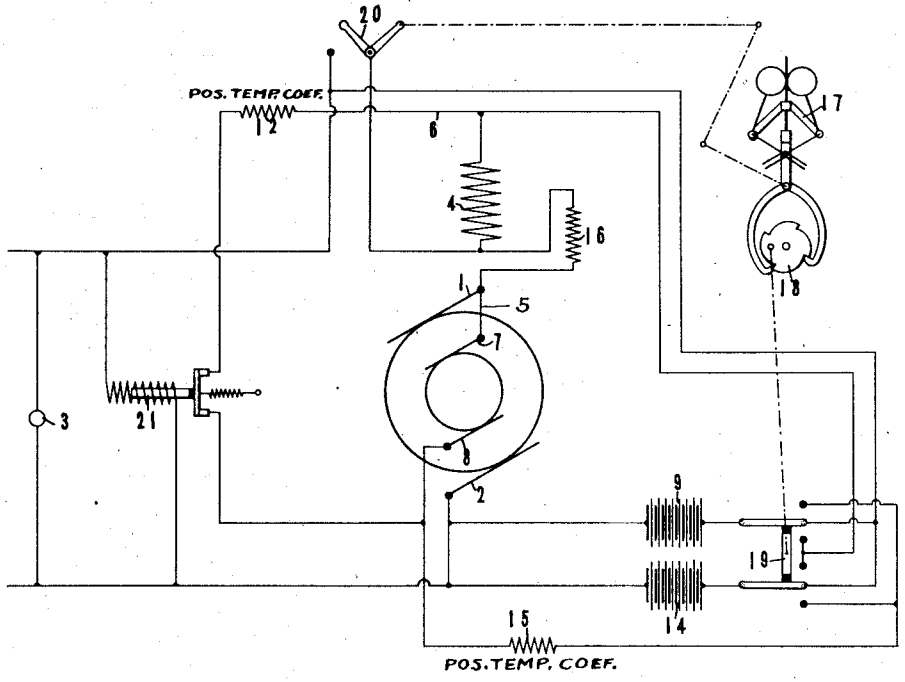


Fig. 4.

Fig. 5.



WITNESSES

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ELECTRICAL SYSTEM.

1,256,223. Specification of Letters Patent. Patented Feb. 12, 1918.

Application filed January 30, 1911. Serial No. 605,629.

To all whom it may concern:

Be it known that I, HUGO GROB, a citizen of Switzerland, and residing at Zurich, Switzerland, have invented certain new and useful Improvements in Electrical Systems, of which the following is a full, clear, and exact description.

This invention relates to an electrical system, and with regard to certain more specific features, to the electric lighting of railway trains or other vehicles.

One object of the invention is to provide a practical and efficient system for maintaining constant the voltage of a translation circuit.

Another object is to provide reliable means for the regulation of the voltage of a circuit where the source of power is a dynamo subject to wide variations of speed.

Another object is to provide a system of the above general nature in which the load-voltage is held substantially constant regardless of variations in the load-current.

Another object is to provide a simple and effective system enabling a variable-speed generator to charge a storage-battery and at the same time to maintain a constant voltage across a translation circuit.

Another object is the provision of a system wherein two storage-batteries may be simultaneously charged at different rates of current flow and yet both be available to supply the load automatically when necessary.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, wherein are shown diagrammatically one or more of various possible embodiments of the several features of my invention,

Figure 1 illustrates a system comprising a generator and exciter therefor;

Fig. 2 is a similar embodiment, but without an exciting dynamo;

Fig. 3 shows an embodiment in which a division of the generator voltage is obtained by means of two separate armature windings; and

Figs. 4 and 5 show the system illustrated in Fig. 4, with additional features.

Similar reference characters refer to similar parts throughout the different views of the drawings.

Referring now to these drawings in detail, Fig. 1 shows conventionally a generator with its field-current derived from a separately excited exciter. At 1 and 2 are illustrated two points, such as terminals of the mains to the translation devices 3, between which it is desired to maintain a constant voltage. A low-resistance excitation winding 4 is mounted on the exciter. The current for this excitation winding 4 is obtained through leads 5, 6, connected to a source of power at the terminals 7, 8.

At 9 is illustrated a current-controlling device which possesses the property of entirely or substantially throttling the current passing through it, when the impressed voltage (that is, the voltage across the device due to the connections between that device and the rest of the apparatus, not any electro-motive force that may be inherent in the device itself) is below a certain critical limit, and of offering but slight resistance to an external current whose voltage impressed on the device 9 is above the said critical limit, so that a slight increase of the impressed voltage above the said limit will be sufficient to cause a considerable amount of current to pass through the device 9. The device 9 may take the form of a galvanic battery, a mercury arc lamp, an electrolytic cell, or other similar apparatus. A galvanic battery, as is well known, allows practically no current to be passed through it unless the impressed voltage is greater than the elec-

tro-motive force of the battery itself, in which case the battery offers but little resistance to the passage of this current. Mercury arc lamps and electrolytic cells act in a similar manner by allowing the passage of current of low voltage in one direction, but preventing currents below a certain impressed voltage from passing in the other direction. As will be explained hereinafter, it is immaterial whether the device 9 has an electro-motive force of its own or not.

The device 9 is connected by a conductor 10 with one terminal of the excitation coil 4 and by the conductor 11 with the point 2. The other terminal of the exciting winding 4 is connnected to the point 1. A resistance 12 is provided between the points 7, 8 and the exciting coil 4, for the purpose of keeping the current passing through the conductors 5, 6 fairly constant regardless of variations in the current in the shunt 10—9—11—2—1. If the voltage across the terminals 7, 8 is not substantially constant, then resistance 12 should be of iron, to limit the current passing through the conductors 5, 6 to a predetermined value regardless of fluctuations in the voltage across the terminals 7, 8.

The current flowing through the excitation coil 4 will obviously be affected by the net electrical opposition (due to electrical resistance, galvanic or dynamic electro-motive force, electro-motive force of polarization, and any other electrical properties) offered by the shunt 10—9—11—2—1 around said coil. If the device 9 has an electro-motive force of its own, as a storage-battery, it is so designed that with the proper generator voltage this electro-motive force, added algebraically to the voltage 1, 2 will almost equal the resistance of the exciting coil 4, multiplied by the current normally in the conductors 5, 6, with the result that almost all the current in the conductors 5, 6 passes through the coil 4, and only a little of it through the shunt 10—9—11—2—1. If the device 9 has no electro-motive force of its own, as a mercury vapor lamp, then its electrical opposition (with the voltage 1, 2 not excessive) is large enough to effect the same result, namely, that almost all the current in the conductors 5, 6 passes through the coil 4. In either case as soon as the generator voltage, which in Fig. 1 is equal to the voltage 1, 2, rises above its proper value, the net electrical opposition of the shunt 10—9—11—2—1 decreases and more of the current in the conductors 5, 6 is thereby diverted through this shunt, leaving a smaller current passing through the coil 4. This reduces the excitation of the generator. The generator voltage is thus maintained at a value just high enough to allow a small current to pass through the shunt 10—9—11—2—1. An increase of generator speed causes a reduction of the excitation, and vice versa. Since the voltage drop across the coil 4 is small owing to its low resistance, the voltage 1, 2 will remain practically equal to the critical voltage of the device 9.

It is, of course, important that the electrical opposition offered by the device 9 be as constant as possible, and independent of the magnitude and duration of the current sent through it. If the device 9 takes the form of a cell with an electrolyte, some well-known electrolyte-stirring apparatus (not shown in the drawings) may be used for this purpose.

In Fig. 2 the exciting coil 4 is on the generator itself, and not on the exciter. Otherwise the system illustrated in this figure operates in the same way as Fig. 1.

In the succeeding figures the exciting coil 4 is illustrated as applied to the generator itself; but it is to be understood that this coil may equally well be instead a part of an exciting dynamo for the generator.

The source of electricity provided between the points 7, 8 may be supplied by the main generator itself, but not from the terminals 1, 2, because the voltage across the points 7, 8 must be of opposite polarity to that across the terminals 1, 2. This effect may be attained by having the voltage 1, 2 equal to only a part of the total generator voltage, the rest of the generator voltage being employed across 7, 8. This division of the generator voltage may be effected by utilizing separate armature windings, as illustrated in Figs. 3, 4 and 5. In the preferred method of dividing the generator voltage, shown in Figs. 3, 4 and 5, the armature conductors are divided into two groups, insulated from each other and each having a commutator; the commutators are provided with brushes 1, 2 and 7, 8, respectively. The connection between brushes 1 and 7 results in a series connection between the brushes 1, 2 and 7, 8.

The current-controlling device 9 may consist of a storage-battery, and in case the battery should be required for storage purposes, it would be desirable to provide for quickly recharging it. Since the conductors 5, 6 deliver only a little more current than the maximum current required by the exciting coil 4, the current flowing normally in the shunt 10—9—11—2—1 would not be sufficient to charge the battery 9 rapidly. However, the greater voltage across the points 2, 8 (Figs. 3, 4 and 5) may be advantageously employed as illustrated in Figs. 4 and 5 for charging a battery 14, which is similar to the battery 9 and which can be ex-

changed for this latter battery from time to time by means hereinafter described. In order to avoid an excessive charging current to the battery 14, a current-limiting device, such as an iron resistance 15, may be provided in the charging circuit. This arrangement illustrated in Figs. 4 and 5 may be used with advantage in connection with plants for the electric lighting, heating or ventilating of railway carriages. In plants of this description, it is often desirable to recharge the battery 14 more quickly when the load is on. This may be effected by arranging a resistance 16 between the brush 1 and the junction of the conductor to the translating devices 3 and that to the exciting winding 4, as illustrated in Figs. 4 and 5. In this case it will be necessary for the generator to generate a sufficient excess of voltage to compensate for the voltage drop across the resistance 16; this excess of voltage, which is substantially proportional to the load, will enable the battery 14 to be charged at a higher rate when the load is on.

The means for exchanging the connections to the two batteries from time to time may take any approved form. I have shown in Fig. 5 a device set forth in detail in my Patent, No. 994,510, granted June 6, 1911, as an illustration of switching mechanism useful in an electrical system on railway cars or other vehicles. At 17 is illustrated a centrifugal governor, adapted to be driven by the motion of the vehicle and to rotate the ratchet wheel 18 one-quarter of a revolution each time the speed of the governor rises above or falls below a predetermined limit. The quarter-revolutions of the ratchet wheel 18 move the switch 19 from the lower or upper position to the central position, or vice versa, as the case may be, and simultaneously operate the switch 20, so as to connect the generator to the translation circuit and the batteries 9, 14 alternatively across the brushes 1, 8 each time the generator speed rises above the critical limit, and to connect the batteries 9, 14 in parallel across the translation circuit and disconnect the generator from said circuit whenever the generator speed drops below this limit.

In Figs. 3, 4 and 5 the battery 9 is being continually charged with a small current, equal to the difference between the current passing through the winding 4 and that passing through the conductors 5, 6. As a result of this continual charging, the counter electro-motive force of the battery and with it the voltage of the whole system will increase with the increase in the extent to which the battery is charged. In order to protect the translating devices 3 from too high a voltage, it is advisable to provide an automatic cut-out device 21 to interrupt the current in the conductors 5, 6 as soon as the voltage of the translation circuit has reached a certain maximum. It will be noted from Fig. 4 that when this circuit is opened by the device 21, the excitation of the generator is then proportional to the difference in potential between brushes 1, 2 and battery 9, as is the case in my Patent No. 994,510, above mentioned. This results in the slow discharge of the battery 9. The same is true of Fig. 5.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an electrical system, in combination, a variable-speed generator, a device which substantially prevents the passage through itself of current at an impressed voltage of less than a predetermined value, means adapted to influence the excitation of the generator, means for delivering a substantially constant current to the terminals of said first means, terminals having a voltage substantially proportional to the total induced voltage of the generator, and a shunt around said first terminals, said shunt including said device and said second terminals.

2. In an electrical system, in combination, a variable speed generator, a device which substantially prevents the passage through itself of current at an impressed voltage of less than a predetermined value, two armature windings on said generator, means adapted to influence the excitation of said generator, a circuit including one of said windings, said means and a resistance, said resistance being adapted to maintain the current through said circuit substantially constant, and a shunt circuit around said means and including said device and the other of said windings.

3. In an electrical system, in combination, a variable speed generator, a device which substantially prevents the passage through itself of current at an impressed voltage of less than a predetermined value, means

adapted to influence the excitation of the generator, circuit connections between said device and said means, said means being responsive to an increase of current forced through said device to reduce the excitation of said generator, a work circuit containing translating devices, a storage battery adapted to be charged by said generator, and means for automatically rendering said first means inoperative when the voltage at the translating devices exceeds a predetermined limit.

In testimony whereof I affix my signature in the presence of two witnesses.

HUGO GROB.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.